AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

LISTING OF CLAIMS:

1. (Original): A control device for a synchronous motor which drives the synchronous motor through a voltage-operated PWM inverter and controls a torque and a speed of the motor, comprising:

phase difference holding means for causing a PWM carrier signal to have an arbitrary phase difference between two phases such as UV, VW or WU in three phases of U, V and W, high frequency extracting means for extracting a high frequency voltage and a high frequency current which are thus generated from a detecting voltage or a command voltage and a detecting current, and position estimating means for estimating a position of a magnetic flux or a position of a magnetic pole by using said extracted high frequency voltage and said extracted high frequency current.

2. (Original): The control device for a synchronous motor according to claim 1, wherein the phase difference holding means generates an arbitrary high frequency on a motor input voltage or current between the two phases such as UV, VW or WU of the inverter, said arbitrary high frequency being other than an output frequency of the voltage-operated PWM inverter.

3. (Original): The control device for a synchronous motor according to claim 1, wherein the frequency extracting means converts the three phases of the motor into a two-phase static coordinate system with α axis and β axis being orthogonal by 90 degrees from each other, in which the U phase of the three phases of the motor is set to be the α axis, and detects a voltage and a current having the arbitrary high frequency components on the α and β axes respectively so that only the arbitrary frequency components can be extracted by means of a band-pass filter.

4. (Original): The control device for a synchronous motor according to claim 1, wherein the position estimating means for estimating a position of a magnetic pole calculates cos 2θ and sin 2θ by means of a magnetic pole position estimator based on said extracted high frequency voltage component and said extracted current component to obtain a magnetic pole position θ by referring to a trigonometric function table.

5. (Original): The control device for a synchronous motor according to claim 1, further comprising a current control device for isolating a detecting current into a directional component of the magnetic pole and a torque component by using the position estimated by the means for estimating a position of a magnetic pole, each being fed back to the current control device respectively so as to control the current.

6. (Currently Amended): The control device for a synchronous motor according to ~~any of claims~~ claim 1 ~~to 5~~, further comprising a speed estimating device for estimating a speed by using the position estimated by the means for estimating a position of a magnetic pole.

7. (Original): The control device for a synchronous motor according to claim 6, further comprising a speed control device for feeding back the speed estimated by the speed estimating device, thereby carrying out a control of the speed.

8. (New): A control device for a synchronous motor , comprising:

a phase shifter operable to cause a PWM carrier signal to have an arbitrary phase difference between two phases such as UV, VW or WU in three phases of U, V and W;

a band-pass filter operable to extract the high frequency voltage and the high frequency current; and

a magnetic pole position estimator operable to estimate a position of a magnetic flux or a position of a magnetic pole by using said extracted high frequency voltage and said extracted high frequency current.

9. (New): The control device according to claim 8, wherein arbitrary high frequency on a motor input voltage or current between is generated between the two phases of the inverter, the arbitrary high frequency being other than an output frequency of the voltage-operated PWM inverter.

10. (New): The control device according to claim 8, wherein the three phases of the motor is converted into a two-phase static coordinate system with α axis and β axis being orthogonal by 90 degrees from each other, in which the U phase of the three phases of the motor is set to be the α axis, and a voltage and a current having the arbitrary high frequency

components on the α and β axes respectively is detected so that only the arbitrary frequency components can be extracted by a band-pass filter.

11. (New): The control device according to claim 8, wherein the magnetic pole position estimator is operable to estimate a position of a magnetic pole by calculating cos 2θ and sin 2θ based on said extracted high frequency voltage component and said extracted current component to obtain a magnetic pole position θ by referring to a trigonometric function table.

12. (New): The control device for a synchronous motor according to claim 8, further comprising a current control device operable to isolate a detecting current into a directional component of the magnetic pole and a torque component by using the position estimated by the magnetic pole position estimator, each being fed back to the current control device respectively so as to control the current.

13. (New): The control device according to claim 8, further comprising a speed estimating device operable to estimate a speed by using the position estimated.

14. (New): The control device according to claim 13, further comprising a speed control device operable to feed back the speed estimated by the speed estimating device, thereby carrying out a control of the speed.